Remarks: General

As no claims have been herein amended, and no claims have been canceled or added, a complete listing of all claims in the application is not being submitted.

An amended version of Fig. 11B is submitted.

A petition under 37 CFR §1.136 for a two-month extension of time to respond the Examiner's action is enclosed, the fee for which should be charged to Deposit Account No. 04-1928 (E.I. du Pont de Nemours and Company). If any other or additional fee is required to authorize or obtain consideration of this response, please charge such fee to Deposit Account No. 04-1928.

Claims 1 and 3~23 remain active in the application. Applicant hereby requests reconsideration and further examination of the application in view of the reasons it has set forth below for allowance of the claims.

Remarks: Detailed Action

I.

The Examiner has objected to the disclosure because of lack of clarity in the brief descriptions of Figs. 11A and 11B. The brief description of both of Figs. 11A and 11B has been corrected, and an amended version of Fig. 11B is being submitted in which the view arrows have been deleted. Applicant therefore respectfully requests that the Examiner withdraw this objection to the disclosure.

II.

The Examiner has objected to the disclosure with respect to the nature of the discussion of the curve depicted in Fig. 13D. Additional discussion of the curve depicted in Fig. 13D has been inserted on page 24. Applicant therefore respectfully requests that the Examiner withdraw this objection to the disclosure.

III.

The Examiner has objected to the disclosure with respect to the addition to the specification in the previous amendment of a recitation as to a lid on the case. By amendment herein, references to the lid have been deleted from the specification while retaining references to the case. Applicant therefore respectfully requests that the Examiner withdraw this objection to the disclosure.

IV.

The Examiner has objected to the drawings because in Figs. 3B, 4C and 11B, the lid of the case is not drawn as a separate structure, and because, in Figs. 11A and 11B, the views contradict the brief description thereof.

As references to the lid have been deleted from the specification, Applicant submits that there is no need to show a lid in any of the figures in the drawings. In addition, the brief description of Figs. 11A and 11B has been amended as noted above, and Fig. 11B itself has been amended to delete the view arrows.

Applicant therefore respectfully requests that the Examiner withdraw this objection to the drawings.

V.

The Examiner has objected to the claims on the basis of a proposed need to rephrase the recitation of "in parallel lines form" in Claim 11.

The use of parallel lines form as a feature of the invention is discussed in the portions of the specification appearing on

page 15 at lines 16~28;
page 17, line 38 to page 18, line 14; and
page 19, line 32 to page 20, line 20.

In view of such discussion, Applicant submits that such feature is appropriately characterized and that Claim 11 need not be amended.

Applicant therefore respectfully requests that the Examiner withdraw this objection to the claims.

In view of the foregoing, Applicant submits that all of the Examiner's objections and rejections have been properly traversed, and that the pending claims are in condition for allowance, request for which is hereby respectfully made.

Respectfully submitted,

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Appendix A
Marked-Up Version of
Currently Pending Form of Deleted Paragraphs
Showing Changes Thereto from Which
Replacement Paragraphs Are Derived

Paragraphs
beginning on page 7 at line 9 and
ending on page 9 at line 2

Figure 3 shows a first embodiment of the present invention of a microstrip line 4-pole HTS mini-filter with self-resonant rectangular spiral resonators with rounded corners, center tuning pads, and parallel lines input/output coupling circuits. Fig. 3a shows the front view thereof, ~~with the lid of the case removed,~~ and Fig. 3b and Fig. 3c show, respectively, the end view and side view thereof.

Figure 4 shows a second embodiment of the present invention of a microstrip line 4-pole HTS mini-filter with self-resonant rectangular spiral resonators, transverse offset inter-resonator coupling adjustment, and inserted line input and output coupling circuits. Fig. 4a shows the front view thereof, ~~with the lid of the case removed,~~ and Fig. 4b and Fig. 4c show, respectively, the end view and side view thereof.

Figure 5 shows a third embodiment of the present invention of a microstrip line 4-pole HTS mini-filter with self-resonant octagon spiral resonators, transverse offset inter-resonator coupling adjustment, and inserted line coupling input and output circuits. Fig. 5a shows the front view thereof, ~~with the lid of the case removed,~~ and Fig. 5b and Fig. 5c show, respectively, the end view and side view thereof.

Figure 6 shows a fourth embodiment of the present invention of a microstrip line 4-pole HTS mini-filter with self-resonant circular spiral resonators, circular center tuning pads, and parallel lines input/output coupling circuits. Fig. 6a shows the front view thereof, ~~with the lid of the case removed,~~ and Fig. 6b and Fig. 6c show, respectively, the end view and side view thereof.

Figure 7 shows a fifth embodiment of the present invention of a microstrip line 5-pole HTS mini-filter with four self-resonant rectangular spiral resonators, one symmetrical double spiral resonator, and inserted line input and output coupling circuits. Fig. 7a shows the front view thereof, ~~with the lid of the case removed,~~ and Fig. 7b and Fig. 7c show, respectively, the end view and side view thereof.

Figure 8 shows a first embodiment of the present invention of a microstrip line mini-multiplexer with two channels. Each channel comprises an 8-pole HTS mini-filter with self-resonant rectangular spiral resonators, and parallel lines input/output coupling circuits. The input circuit of the multiplexer is in the binary splitter form. Fig. 8a shows the front view thereof, ~~with the lid of the case removed,~~ and Fig. 8b and Fig. 8c show, respectively, the end view and side view thereof.

Figure 9 shows a second embodiment of the present invention of a microstrip line mini-multiplexer with four channels. Each channel comprises an 8-pole HTS mini-filter with self-resonant rectangular spiral resonators, and parallel lines input/output coupling circuits. The input circuit of the multiplexer is in the cascaded binary splitter form. Fig. 9a shows the front view thereof, ~~with the lid of the case removed,~~ and Fig. 9b and Fig. 9c show, respectively, the end view and side view thereof.

Figure 10 shows a third embodiment of the present invention of a microstrip line mini-multiplexer with four channels. Each channel comprises an 8-pole HTS mini-filter with self-resonant rectangular

spiral resonators, and parallel lines input/output coupling circuits. The input circuit of the multiplexer is in the multi-branch line form. Fig. 10a shows the front view thereof, ~~with the lid of the case removed,~~ and Fig. 10b and Fig. 10c show, respectively, the end view and side view thereof.

Figure 11 shows an embodiment of the present invention of a strip line 4-pole HTS mini-filter with self-resonant rectangular spiral resonators with rounded corners, center tuning pads, and parallel lines input/output coupling circuits. Fig. 11a ~~is a side view of the mini-filter~~shows the front view thereof, and Fig. 11b ~~is a plan view as seen along lines and arrows A-A of Fig. 11a~~shows the side view thereof.

Paragraphs beginning at line 33 and ending on page 24 at line 33

Fig. 3 shows a first embodiment of the 4-pole HTS mini-filter circuit having four self-resonant spiral resonators (in this case having a rectangular configuration with rounded corners) as its frequency selecting element. Fig. 3a shows the top or front view of the filter~~with the lid of the case removed~~, Fig. 3b shows an end view, and Fig. 3c shows a side view. In Figures 3a, 3b and 3c, numeral 30 is a dielectric substrate with a front side and a back side. The HTS filter mini-circuit is disposed on the front side of the substrate 30 as shown in Fig. 3a, 3b and 3c. The back side of the substrate 30 (which is seen in the views of Fig. 3b and Fig. 3c but is not seen in the view of Fig. 3a) is disposed with a blank HTS film 31 (see Fig. 3b and Fig. 3c) serving as the ground of the mini-filter circuit. A gold film 32 (see Fig. 3b and Fig. 3c) is disposed on top of HTS film 31 and functions as the contact to the mini-filter's case 32a, shown in Figs. 3a, 3b and 3c. ~~The case lid 32b is shown in Figs. 3b and 3c.~~ In Fig. 3a, numerals 33, 34, 33a, and 34a are four self-resonant rectangular spiral resonators with rounded corners. The inter-resonator couplings are provided by the coupling gaps, 38, 38a, and 38b, between the adjacent resonators. The input coupling circuit is in a parallel lines form, which comprises an input line 35 and the coupling gap 39 between 35 and the first resonator 33. The output coupling circuit is in a parallel lines form, which comprises an output line 35a and the coupling gap 39a between 35a and the last resonator 33a. Two tuning pads 36, 36a are placed at the center of resonators 34 and 34a, respectively, for fine tuning the resonant frequency of the resonators 34 and 34a. Gold connecting pads 37 and 37a are disposed on the input and output line 35 and 35a, respectively, providing the connections to the mini-filter's input and output connectors 37b and 37c, respectively, shown in Figs. 3a and 3c.

Fig. 4 shows a second embodiment of the 4-pole HTS mini-filter circuit having four self-resonant rectangular spiral resonators as its frequency selecting element, in which Fig. 4a shows the top or front view of the filter~~ with the case removed~~, Fig. 4b shows an end view, and Fig. 4c shows a side view. Numeral 40 is a dielectric substrate with a front side and a back side. The HTS mini-filter circuit is disposed on the front side of the substrate 40 as shown in Figs. 4a, 4b and 4c. As indicated by the views shown in Figs. 4b and 4c, the back side of the substrate 40 is disposed with a blank HTS film 41 serving as the ground of the mini-filter circuit, and a gold film 42 is disposed on top of 41 serving as the contact to the mini-filter's case 42a, shown in Figs. 4a~4c. ~~The case lid 42b is shown in Figs. 4b and 4c.~~ In Fig. 4a, numerals 43, 44, 43a, and 44a are the four self-resonant rectangular spiral resonators. The inter-resonator couplings are provided by the coupling gaps 49, 49a, 49b between adjacent resonators. In this particular case, the inter-resonator coupling strength is adjusted by changing the gap width between the adjacent resonators, as well as by shifting the resonator's location in the transverse direction for the fine adjustment. The input coupling circuit is in the inserted line form, which comprises an input line 45 with its extended narrower line 46 inserted into the split spiral line of the first resonator 43 with a coupling gap 47 between them. The output coupling circuit is in the inserted line form, which comprises an output line 45a with its extended narrower line 46a inserted into the split spiral line of the last resonator 43a with a coupling gap 47a between them. Gold connecting pads 48 and 48a are disposed on the input and output lines 45 and 45a, respectively, providing the connections to the mini-filter's input and output connectors 48b and 48c, respectively, shown in Figs. 4a and 4c.

Fig. 5 shows a third embodiment of the 4-pole HTS mini-filter circuit having self-resonant four octagon spiral resonators as its frequency selecting element, in which Fig. 5a shows the top or front view~~ with the lid of the case removed~~, Fig. 5b shows an end view, and Fig. 5c shows a side view. Numeral 50 is a dielectric substrate with a front side and a back side. The HTS mini-filter circuit is disposed on

the front side of the substrate 50 as shown in Figs. 5a~5c. As indicated by the views shown in Fig. 5b and Fig. 5c, the back side of the substrate 50 is disposed with a blank HTS film 51 serving as the ground of the mini-filter circuit, and a gold film 52 is disposed on top of blank HTS film 51 serving as the contact to the mini-filter's case 52a, shown in Figs. 5a~5c. ~~The case lid 52b is shown in Figs. 5b and 5c.~~ In Fig. 5a, numerals 53, 54, 53a, and 54a are the four self-resonant octagon spiral resonators. The inter-resonator couplings are provided by the coupling gaps 59, 59a, 59b, between adjacent resonators. In this particular case, the inter-resonator coupling strength is adjusted by changing the gap width between the adjacent resonators, as well as by shifting the resonator's location in the transverse direction for the fine adjustment. The input coupling circuit is in the inserted line form, which comprises an input line 55 with its extended line 56 inserted into the split spiral line of the first resonator 53 with a coupling gap 57 between them. The output coupling circuit is in the inserted line form, which comprises an output line 55a with its extended line 56a inserted into the split spiral line of the last resonator 53a with a coupling gap 57a between them. Gold connecting pads 58 and 58a are disposed on the input and output lines 55 and 55a, respectively, providing the connections to the mini-filter's input and output connectors 58b and 58c, respectively, shown in Figs. 5a and 5c.

Fig. 6 shows a fourth embodiment of the 4-pole HTS mini-filter circuit having four self-resonant circular spiral resonators as its frequency selecting element, in which Fig. 6a shows the circuit top or front view ~~with the lid of the case removed~~, Fig. 6b shows the end view, and Fig. 6c shows the side view. Numeral 60 is a dielectric substrate with a front side and a back side. The HTS mini-filter circuit is disposed on the front side of the substrate 60 as shown in Figs. 6a~6c. As indicated by the end view shown in Fig. 6b and the side view shown in Fig. 6c, the back side of the substrate 60 is disposed with a blank HTS film 61 serving as the ground of the mini-filter circuit, and a gold film 62 is disposed on top of blank HTS film 61 serving as the contact to the mini-filter's case 62a, shown in Figs.

6a~6c. ~~The case lid 62b is shown in Figs. 6b and 6c.~~ In Fig. 6a, numerals 63, 64, 63a, and 64a are the four self-resonant circular spiral resonators. The inter-resonator couplings are provided by the coupling gaps 63b, 63c, 63d, between adjacent resonators. The input coupling circuit is in the parallel line form, which comprises an input line 66 and an extended line 67, the input coupling is provided by the gap 69 between 67 and the first resonator 63. The output coupling circuit is in the parallel line form, which comprises an output line 66a and an extended line 67a, the output coupling is provided by the gap 69a between 67 and the first resonator 63. Two tuning pads 65, 65a are placed at the center of resonators 63 and 63a, respectively, for fine tuning the resonant frequency of the resonators 63 and 63a. Gold connecting pads 68 and 68a are disposed on the input and output lines 66 and 66a, respectively, providing the connections to the mini-filter's input and output connectors68b and 68c, respectively, shown in Figs. 6a and 6c.

Fig. 7 shows one embodiment of a 5-pole HTS mini-filter circuit having five self-resonant rectangular spiral resonators as its frequency selecting element, in which Fig. 7a shows the circuit top or front view ~~with the lid of the case removed~~, Fig. 7b shows the end view, and Fig. 7c shows the side view. Numeral 70 is a dielectric substrate with a front side and a back side. The HTS mini-filter circuit is disposed on the front side of the substrate 70 as shown in Figs. 7a~7c. As indicated by the end view shown in Fig. 7b and the side view shown in Fig. 7c, the back side of the substrate 70 is disposed with a blank HTS film 71 serving as the ground of the mini-filter circuit, and a gold film 72 is disposed on top of blank HTS film 71 serving as the contact to the mini-filter's case 72a, shown in Figs. 7a~7c. ~~The case lid 72b is shown in Figs. 7b and 7c.~~ In Fig. 7a, numerals 73, 74, 73a, and 74a are the four self-resonant rectangular single spiral resonators, numeral 75 is a self-resonant rectangular double spiral resonator, which is centrally located and thus serves as the middle resonator. The use of double spiral resonator 75 at the middle of the 5-pole filter is to make the circuit geometry symmetrical with respect to the input and the output. This approach is also suitable for any symmetrical

mini-filter with odd number poles. The inter-resonator couplings are provided by the coupling gaps 75a, 75b, 75c, 75d, between adjacent resonators. In this particular case, the inter-resonator coupling strength is adjusted by changing the gap width between the adjacent resonators. The input coupling circuit is in an inserted line form, which comprises an input line 76 with its extended narrower line 77 inserted into the split spiral line of first resonator 73 with a coupling gap 78 between them. The output coupling circuit is in a inserted line form, which comprises an output line 76a with its extended narrower line 77a inserted into the split spiral line of last resonator 73a with a coupling gap 78a between them. Gold connecting pads 79 and 79a are disposed on the input and output lines 76 and 76a, respectively, providing the connections to the mini-filter's input and output connectors 79b and 79c, respectively, shown in Figs. 7a and 7c.

Fig. 8 shows a 2-channel mini-multiplexer, each channel has a 8-pole HTS mini-filter 83, 83a (see Fig. 8a), respectively, with eight rectangular self-resonant spiral resonators. Fig. 8a shows the top or front view~~ with the lid of the case removed~~, Fig. 8b shows the end view, and Fig. 8c shows the side view. Numeral 80 is a dielectric substrate with a front side and a back side. The HTS mini-multiplexer circuit is disposed on the front side of substrate 80 as shown in Figs. 8a~8c. As indicated by the end view shown in Fig. 8b and the side view shown in Fig. 8c, the back side of the substrate 80 is disposed with a blank HTS film 81 serving as the ground of the mini-multiplexer circuit, and a gold film 82 is disposed on top of blank HTS film 81 serving as the contact to the mini-multiplexer's case 82a, shown in Figs. 8a~8c. ~~The case lid 82b is shown in Figs. 8b and 8c.~~ The frequency bands of mini-filters 83 and 83a are slightly different and without overlapping to form two channels. As shown in Fig. 8a, the input coupling circuits of mini-filters 83 and 83a are in the parallel lines form, which comprise input lines 84 and 84a and the gaps 84b, 84c, respectively, between input lines 84 and 84a and the first spiral resonator of filters 83 and 83a, respectively. A distribution network in a single binary splitter form serves as the input of the multiplexer, which comprises the common input line 86, a T-junction

87, and branch lines 85 and 85a, with one end of each of the branch lines 85 and 85a commonly connected to T-junction 87, and the other end thereof connected to coupling lines 84 and 84a, respectively. The dimensions of coupling lines 84 and 84a, branch lines 85 and 85a, common input line 86 and T-junction 87 are selected in such a way to provide the input impedance matching of the mini-multiplexer over the frequency range covering the two frequency bands of filters 83 and 83a. The output coupling circuits of filters 83 and 83a are in the parallel lines form, which comprise the output lines 87a and 87b, and the gap 87c, 87d, respectively, between them and the last resonator of filters 83 or 83a. Output lines 87a and 87b also serve as the output lines for the two channels of the mini-multiplexer. Gold connecting pads 88, 88a and 88b are disposed on the input line 86, and output lines 87a and 87b, respectively, providing the connections to the mini-multiplexer'sinput connector 89 and the two output connectors 89a and 89b, shown in Figure 8a.

It should be understood that the form of the self-resonant spiral resonators in the mini-multiplexer is not restricted to the rectangular form illustrated in Fig. 8, but rather they can be of any configuration such as shown in Figs. 2a-2d or combinations thereof. Further it is to be understood that the form of the input and output coupling circuits of the mini-filters in the mini-multiplexer is not restricted to the parallel line form shown in Fig. 8, but instead other line forms may be used, such as the inserted line form or combinations of inserted line form and parallel line form.

Fig. 9 shows a second embodiment of the 4-channel mini-multiplexer, each channel having an 8-pole HTS mini-filter with eight self-resonant rectangular spiral resonators, in which Fig. 9a shows the top or front view~~ with the lid of the case removed~~, Fig. 9b shows the end view, and Fig. 9c shows the side view. Numeral 90 is a dielectric substrate with a front side and a back side. The HTS mini-multiplexer circuit is disposed on the front side of substrate 90 as shown in Figs. 9a~9c. As indicated by the end view shown in Fig. 9b and the side view shown in Fig. 9c, the back side of the substrate 90 is

disposed with a blank HTS film 91 serving as the ground of the mini-multiplexer circuit, and a gold film 92 is disposed on top of blank HTS film 91 serving as the contact to the mini-multiplexers case 98 shown in Figs. 9a~9c. ~~The case lid 99 is shown in Figs. 9b and 9c.~~ In Fig. 9a, numerals 93 and 93a are used to designate two 2-channel mini-multiplexers similar to that shown in Fig. 8. The frequency bands of mini-multiplexers 93 and 93a are slightly different and without overlapping. As shown in Fig. 9a, the distribution network at the input of the 4-channel mini-multiplexer is in a 2-stage cascaded binary splitter form. The first stage comprises a common input line 95, a T-junction 96 and two branch lines 94 and 94a, with one end of each of the branch lines 94 and 94a commonly connected to T-junction 96, and the other end thereof connected to the input lines 94b and 94c, respectively, of the second stage. The second stage comprises two binary splitters, which actually are the input binary splitters of the two 2-channel mini-multiplexers 93 and 93a, and comprise input lines 94b and 94c; T-junctions 94d and 94e; branch lines 94f, 94g, 94h and 94i; and input lines 94j, 94k, 94l and 94m, as shown in Fig. 9a. The dimensions of mini-multiplexers 93 and 93a, branch lines 94 and 94a, input lines 94b and 94c, T-junctions 94d and 94e, branch lines 94f, 94g, 94h and 94i, input lines 94j, 94k, 94l and 94m, common input line 95 and T-junction 96 are selected in such a way to provide the input impedance matching of the mini-multiplexer over the frequency range covering the four frequency bands of the 4-channel mini-multiplexer. The output circuits of the 4-channel mini-multiplexer comprise the two 2-channel mini-multiplexers' output lines: 97, 97a, 97b, 97c, which serve as the four output lines for the 4-channel mini-multiplexer as shown in Fig. 9a.

Fig. 10 shows a third embodiment of the 4-channel mini-multiplexer, each channel comprising an 8-pole HTS mini-filter 103, 103a, 103b, 103c (see Fig. 10a), with eight self-resonant rectangular spiral resonators. Fig. 10a shows the top or front view ~~with the lid of the case removed~~, Fig. 10b shows the end view, and Fig. 10c shows the side view. Numeral 100 is a dielectric substrate with a front side and a back side. The HTS mini-multiplexer circuit is disposed on the

front side of substrate 100 as shown in Figs. 10a~10c. As indicated by the end view shown in Fig. 10b and the side view shown in Fig. 10c, the back side of the substrate 100 is disposed with a blank HTS film 101 serving as the ground of the mini-multiplexer circuit, and a gold film 102 is disposed on top of blank HTS film 101 serving as the contact to the mini-multiplexer's case 109, shown in Figs. 10a~10c. ~~The case lid 109a is shown in Figs. 10b and 10c.~~ The frequency bands of filters 103, 103a, 103b, and 103c are slightly different and without overlapping to form four channels. As shown in Fig. 10a, the distribution network at the input of the 4-channel mini-multiplexer is in a matched branch lines form, which comprises a common input line 106, a matching section 105, line sections 104, 104a, 104b, 104c, and five junctions: 107, 107a, 107b, 107c and 107d. The dimensions of line sections 104, 104a, 104b and 104c, matching section 105, common input line 106, and junctions 107, 107a, 107b, 107c and 107d, are selected in such a way to provide the input impedance matching of the mini-multiplexer over the frequency range covering the four frequency bands of the 4-channel mini-multiplexer. The output circuits of the 4-channel mini-multiplexer comprise the four mini-filter's output lines: 108, 108a, 108b, 108c, which serve as the four output lines for the 4-channel mini-multiplexer as shown in Fig. 10a.

Fig. 11 shows an example of a 4-pole HTS filter in the strip line form with four rectangular self-resonant spiral resonators with rounded corners as its frequency selecting element. Fig. 11a is a side view of the filter and Fig. 11b is a view as seen along lines and arrows A-A of Fig. 11a. Numeral 110 is a dielectric substrate with a front side and a back side. The HTS filter circuit 113 is disposed on the front side of substrate 110 as seen in Fig. 11b. As shown in Fig. 11a, a first blank HTS film 111 is disposed on the back side of substrate 110 serving as one of the two ground planes for the strip line, a first gold film 112 is disposed on top of first blank HTS film 111 serving as the contact to the filter's case 118, shown in Figs. 11a and 11b. Numeral 110a is a dielectric superstrate with a front side and a back side. As shown in Fig. 11a, a second blank HTS film 111a is disposed on the

back side of superstrate 110a serving as one of the two ground planes for the strip line, a second gold film 112a is disposed on top of second blank HTS film 111a serving as the contact to the filter's case ~~lid~~ ~~119~~118, shown in Fig. 11a. As is also shown in Fig. 11a, superstrate 110a is smaller in size than substrate 110, whereby the first end (e.g., microstrip line 115 and gold contact pad 116) of the input coupling circuit and the first end (e.g., microstrip line 115a and gold contact pad 116a) of the output coupling circuit are each located outside the dimensions of superstrate 110a, that is, they are not covered by superstrate 110a. Although not shown, it is understood that the mirror image of HTS filter circuit 113 could also be disposed on the front side of superstrate 110a and the two mirror image circuits aligned. As shown in Fig. 11b, the input and output strip lines 114 and 114a are extended into broader microstrip lines 115 and 115a, respectively, on the substrate 110. Gold contact pads 116 and 116a are disposed on microstrip lines 115 and 115a, respectively (also seen in Fig. 11a), providing the connections to the filter input and output connectors 117 and 117a , respectively, shown in Figs. 11a and 11b. The line width of output strip lines 114 and 114a, and microstrip lines 115 and 115a, are selected in such a way to achieve the impedance matching at the input and the output.

In all of the embodiments described above, it is preferred that the high temperature superconductor is selected from the group consisting of $YBa_2Cu_3O_7$, $Tl_2Ba_2CaCu_2O_8$, $TlBa_2Ca_2Cu_3O_9$, $(TlPb)Sr_2CaCu_2O_7$ and $(TlPb)Sr_2Ca_2Cu_3O_9$. It is also preferred that the substrate and superstrate are independently selected from the group consisting of $LaAlO_3$, MgO, $LiNbO_3$, sapphire and quartz.

EXAMPLE

A mini-filter having the circuit layout shown in Figure 12 was prepared. It is a 3-pole 0.16 GHz bandwidth centered at 5.94 GHz mini filter in the microstrip line form. It consists of three rectangular self-resonant spiral resonators, 121, 121a, 121b, each having a tuning pad at the center, 122, 122a, 122b, parallel lines input and output coupling circuits, 123, 123a. The substrate 120 is made of $LaAlO_3$

with dimensions of 5.250 mm x 3.000 mm x 0.508 mm. The HTS thin film is $Tl_2Ba_2CaCu_2O_8$. The filter was fabricated, and tested at 77 K. The measured S-parameter data are shown in Fig. 13, in which Fig. 13a shows S_{11} versus frequency data, Fig. 13b shows S_{12} versus frequency data, Fig. 13c shows S_{21} versus frequency data, Fig. 13d shows S_{22} versus frequency data. S_{11} is the magnitude of the reflection coefficient from the input port; S_{21} is the magnitude of the transmitting coefficient from the input port to the output port; S_{22} is the magnitude of the reflection coefficient from the output port; and S_{12} is the magnitude of the transmitting coefficient from the output port to the input port. The results show that the center frequency is about 5.95 GHz and the band width is about 170 MHz. The return loss is about 12 dB as measured by S_{11} (see~~, e.g.,~~ Fig. 13a, wherein the scale along the ordinate axis is 5 dB per division), and 8 dB as measured by S_{22} (see Fig. 13d, same scale). Reference to Fig. 13b or 13c shows there is essentially zero insertion loss. The measured data were in agreement with the computer simulated data very well, the center frequency difference was less than 0.1%.